The use of megavoltage radiation to treat juvenile mandibular ossifying fibroma in a horse

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An 8-month-old, Thoroughbred filly was presented to the Ontario Veterinary College (OVC) for evaluation of an enlarging mass involving the rostral portion of the mandible. The mass was noted several weeks after there had been a traumatic injury to the jaw. At the time of admission, there was a firm ulcerated mass, 9.5 × 9 × 13.5 cm in size, involving the body of the mandible, extending from the symphysis of the mandible to the interdental space, and into and between the incisors. Radiographs revealed a large, bony, dense mass of homogenous texture and density. A tentative diagnosis of equine juvenile mandibular ossifying fibroma (JMOF) was made based on the clinical and radiographic appearance of the lesion. The mass was surgically debulked with the horse under general anesthesia. Intraoperative radiographs were taken to help evaluate the amount of tumor left to remove. Histological examination of the mass confirmed the clinical and radiographic diagnosis of JMOF. The tissue consisted of variably sized spicules of mature woven bone, lined by a layer of osteoblasts and surrounded by irregular whorls of loosely woven fibrous tissue.

The filly recovered uneventfully from surgery and was discharged. Six months later, she was readmitted to the OVC with a recurrent proliferative mandibular mass, significantly larger than the initial lesion. The mass had recurred within several weeks of the surgery. The mass now involved most of the rostral part of the body of the mandible, as well as both interdental spaces. Due to the poor prognosis for continued surgical debulkment and the owner's reluctance to pursue rostral mandibulectomy, radiation therapy was initiated.

The mandible received a total midline dose of 4000 cGy from a ceiling mounted, Cobalt 60 Picker unit with a source surface distance of 80 cm in 10 fractions on a Monday, Wednesday, and Friday schedule over 22 d. The horse was positioned in a portable stock with the head immobilized in a secure position to allow for accurate placement of the radiation beam. The mass was treated with a bilateral parallel opposed pair technique. The radiation portal encompassed the tumor and a margin of normal tissue. The horse was sedated each time with 5 mg detomidine (Dormosedan, SmithKline Beecham, London, Ontario), IV. During the course of treatment, the oral mucosa became red and inflamed. Saliva production increased and became tenacious in nature and a strong odor developed from the mass. Despite the acute side effects of the radiation, the filly continued to eat, and these side effects lessened in the 4 wk following the final treatment. Serial follow-up radiographs were taken immediately after the radiation treatment, and at 2 and 10 mo. Radiographically, the mass appeared the same size but was less radiodense at 10 mo. Clinical follow-up of the filly revealed progressive decrease in size of the neoplastic mass at 1 y after the radiation therapy. Two years after radiation therapy, the owner reported that the filly was doing well, with no visible external evidence of the JMOF.

Benign proliferative fibro-osseous lesions of the rostral part of the body of the mandible in the horse are a relatively rare neoplasia (1), although several cases have been described (2,3). These productive, rapidly growing, lesions of the rostral part of the mandible have been described variously as ossifying fibroma-osteoma, osteoma, and osteosarcoma (4,2). In a review of the clinical, radiographic, surgical and pathological data of 6 horses, Morse *et al* (1988) felt that this clinicopathological syndrome should be distinctly classified as JMOF.

Ossifying fibromas are seen most commonly in young horses aged 2 mo to 1 y. Historical evaluation of 5 cases of JMOF suggests that trauma may be a predisposing factor; however, the young age observed both in humans and horses suggests a strong developmental connection (2). Ossifying fibromas are characterized histologically by dense fibroblastic stroma with isomorphic mesenchymal cells, along with fibroblasts and osteoblasts (5). The osteoblasts line relatively regular spicules of bone within a moderately vascularized fibro-osseous stroma. Ossifying fibromas can be distinguished from fibrous dysplasias by the lack of osteoclasts lining the bony spicules in fibrous dysplasias (5). The connective tissue cells of osteosarcomas are pleomorphic and have a high mitotic index, which is absent in ossifying fibromas (5). Although the lesion is locally highly invasive, it has not been reported to have metastatic qualities. A tentative clinical diagnosis of JMOF can be made on the basis of history, signalment, clinical findings, and radiographic appearance of the lesion. Histological examination of the lesion will distinguish JMOF from other progressive, proliferative lesions of the mandible.

Surgical excision, radiation therapy, and cryotherapy have been described for the treatment of various types of mandibular neoplasms in the dog and cat (6–9). Surgical excision of the lesion in the horse appears to result in a high rate of recurrence, although rostral mandibulectomy has been successful (3). Rostral mandibulectomy is a relatively simple procedure in the horse, has a good long-term outcome with regards to cosmetics and function, and in one study, resulted in no complications or recurrence of the neoplasm (3). Radiation therapy has not been described in the literature for use in the horse for the sole treatment of JMOF; however 1 horse with

Can Vet J 1996; 37: 683–684

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JMOF has been reported to have received radiation therapy following surgical debulkment of the lesion (3).

Radiation therapy uses ionizing radiation to treat neoplasias. The goal is to deliver an adequate dose of radiation to the localized tumor volume, while not exceeding normal tissue tolerance in the surrounding area (10). Evidence indicates that chromosomal DNA is the principal target for radiation-induced lethality (10). Radiation therapy can be delivered through external beam therapy or with brachytherapy (10).

External beam therapy includes X-rays or gamma rays from megavoltage equipment, such as linear accelerators and Cobalt 60 machines (energies of 1.25 MV and higher), or orthovoltage equipment (300 kV and below) (9). The penetration of the beam increases as the energy of the machine increases (10). With Cobalt 60, the 100% maximum dose is achieved at a depth of 0.5 cm, while a 6MV linear accelerator achieves maximum dose at a depth of 1.5 cm. With low energy X-rays of superficial and orthovoltage machines, the maximum dose is deposited on the surface with the percentage depth dose falling off rapidly depending on the kV and HVT (half value thickness) (10). In this case, Cobalt 60 is an appropriate method of radiation therapy, as the bulk of the tumor is close to or involving the surface of the mandible.

In achieving control of a tumor, it is necessary to deliver an adequate dose of radiation to the total tumor volume, while avoiding unacceptable acute or late effects to the normal tissues (12). The ultimate sterilization of a tumor and cell killing is a random process, dependent on a number of factors. Through dose response curves, it has been shown that the deliverance of a total radiation dose in smaller fractions allows a higher total dose to be given to the tumor with fewer complications to normal tissue and, ultimately, greater tumor control (10). The response of a particular tissue to radiation depends on many factors, including repair, reoxygenation and repopulation, and redistribution of cells within the cell cycle (10). In rapidly dividing cells, the results of the radiation may be evident sooner; whereas in slowly dividing cells, the expression of radiation damage will not be evident until cellular reproduction is attempted. This explains the slow resolution of the tumor mass in this case.

Radiation therapy has been used to treat many cutaneous neoplasms in the horse, including squamous cell carcinoma, fibrous connective tissue tumors, sarcoids, and solitary lymphomas (11,12). Radiation therapy is often combined with surgery, as surgical excision reduces the tumor burden (6); however, the efficacy of adjunct radiation therapy and surgery has not been evaluated in the horse. The 2-year follow-up in this case showed no evidence of recurrence of the mass. The horse returned to the herd to graze normally within weeks after completion of treatment. The radiation procedure was tolerated very well and resulted in a good cosmetic result. Megavoltage radiation should be considered as the sole treatment or as an adjunct to surgery in the management of JMOF. CVJ

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